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A TWO-CELL CHAMBER FOR MEASURING GAS EXCHANGE IN TREE SEEDLINGS

Abstract.—A two-celled chamber for measuring gas exchange in tree seedlings is described. Temperature is controlled within ± 0.5° C by means of a copper coil. The two cells are independent of one another, and one cell can be used as a preconditioning cell while gas exchange measurements are being made in the second cell.

We constructed a chamber to measure gas exchange in forest tree seedlings. Even though several chambers have been described in the literature (*Broerman et al. 1967*; *Ronco 1969*; and *Bate and Canvin 1971)*, none was found that met our specifications and budget limitations. Our chamber has two independent cells for measurement of gas exchange, good temperature control, a wide temperature range, and variable light control; and it is reasonably inexpensive.

Description of Chamber

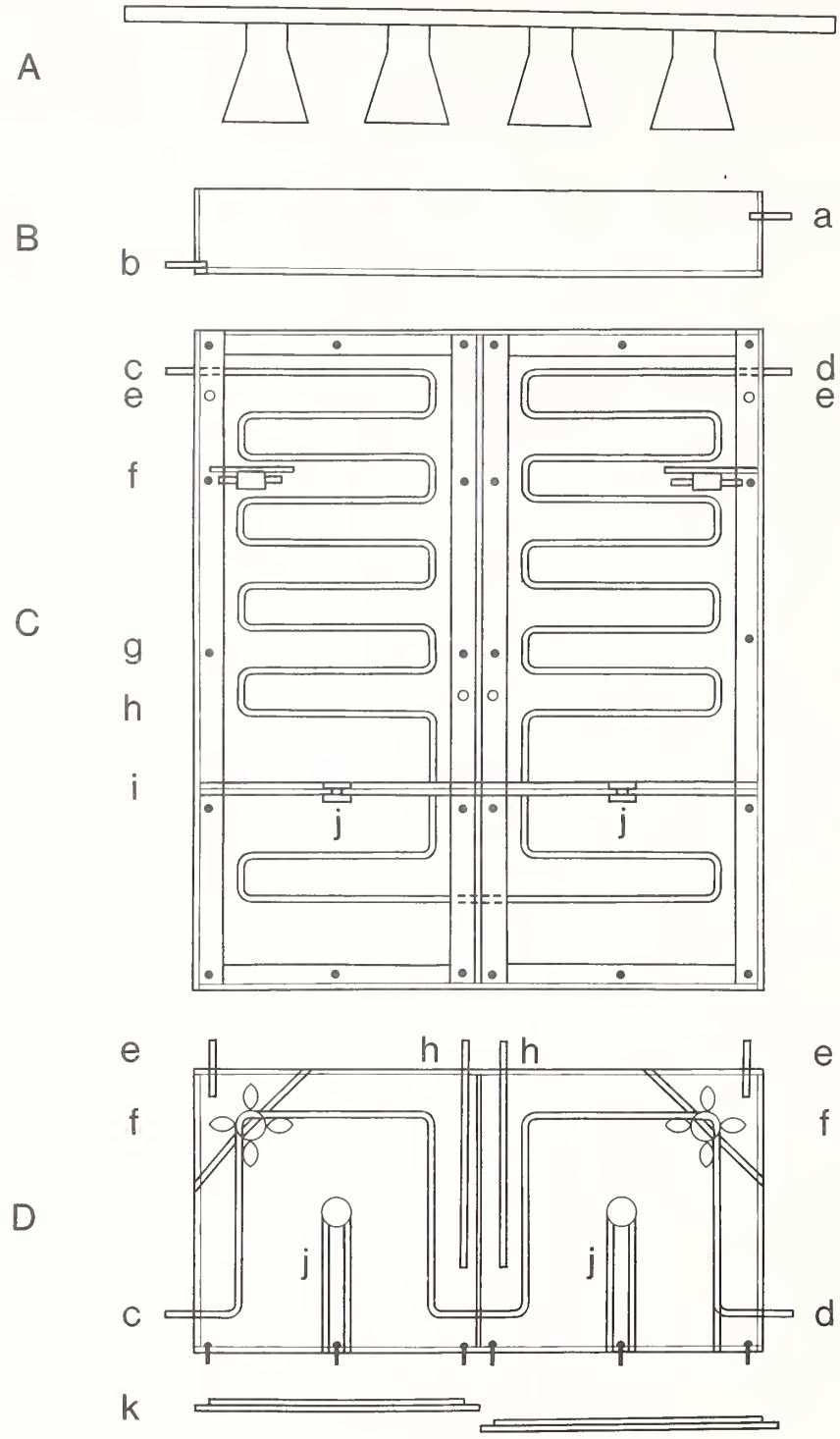
The chamber, constructed of ¼-inch plexiglas, consists of two cells, each 12 inches square and 28 inches high (fig. 1). A shelf made of two layers of ¼-inch plexiglas is placed 9 inches above the floor of each cell. An opening, consisting of a 1-inch slot in the top layer of plexiglas and a ⅝-inch slot in the bottom layer of plexiglas, leads to a 1-inch hole in the center of the shelf. A slide to fill the slot in the shelf is constructed of two 1-inch pieces of ¼-inch plexiglas glued to either side of a ¼-inch piece of plexiglas ⅝ inches wide. The slide reaches from the front edge of the shelf to the edge of the center hole.

A 1-inch strip of ¼-inch plexiglas is glued around the front edge of each cell. Bolts are glued to the strip at approximately 6-inch intervals to fasten the door to the cell. Each door consists of a flat piece of ¼-inch plexiglas with holes to match the bolts on each cell. Quarter-inch tygon tubing is glued to the back of each door to press against the strips on the front of the cell and prevent air exchange around the door. Two glass tubes are connected into the top and bottom of each cell as an inlet and outlet for gas sampling. A muffin fan in each cell is used for air circulation.

The heat filter on top of the chamber is also constructed of ¼-inch plexiglas. It is 12 x 24 x 3 inches with an inlet and outlet that maintain the water level at about 2 inches.

A system of ⅜-inch rigid copper pipe forms a cooling coil on three sides of each cell. The continuous system has nine loops above the shelf and two loops below the shelf in each cell. The flow of water through the coil is con-

Figure 1.—The two-cell chamber. A, light bank. B, heat filter: a, outlet; b, inlet. C, front view of chamber: c, inlet for cooling system; d, outlet for cooling system; e, air inlet; f, muffin fans; g, bolt; h, air outlet; i, shelf; j, slide in shelf. D, top view of chamber: k, door with tygon tubing seal.



trolled with a Fenwal-type thermoregulator in one cell. The light bank consists of eight 300-watt floodlights.

Operational Procedure

To use the chamber, connect the heat filter with a water supply. Allow the filter to fill with water and to overflow continuously at a slow rate. This will remove most of the heat from the lights.

Depending on its height, the seedling can be placed either on the shelf or below the shelf. If the pot and seedling are less than 19 inches tall, place the pot in a plastic bag and seal it around the stem. Then place the pot on top of the shelf in which the center hole has been plugged. If the pot and plant are over 19 inches tall, place the pot below the shelf with the stem up through the center hole. Seal the hole around the stem with a stopper to prevent gas exchange through the shelf area. Place the door on the cell and tighten the wing nuts to prevent gas exchange around the door.

After the fan and lights are turned on, the solenoid on the cooling coil connected to the thermoregulator is activated and opens or closes depending on the desired temperature. The solenoid may be placed either on a cold water line to maintain temperatures between water temperature and ambient temperature or on a constant temperature bath to maintain temperatures between 0 and 40° C. Temperature can be maintained within $\pm$ 0.5 C.

A second plant can be placed in the second cell concurrently with the first plant or at a later time without any interference to the first cell. If the second cell is not going to be used, the door should be closed to maintain the desired temperature.

The light bank can be wired to a powerstat to vary light intensities. The maximum light intensity is 4,500 foot-candles.

The chamber is versatile and can be used for different types of gas exchange measurements. We have attached it to an MSA infrared gas analyzer for carbon dioxide measurements. One cell is used as a preconditioning chamber while gas exchange is measured in the second cell. Many types of photosynthesis and respiration measurements can be made by using an array of connections or airflow systems.

We constructed the chamber from materials costing about $125.00, excluding the thermoregulator, solenoid, and powerstat.

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